Mechanisms of growth and photosynthetic inhibition of a southern African geophyte (*Tritonia crocata*) by an invasive European annual grass (*Lolium multiflorum*)

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The rapid spread of European annual grasses in Mediterranean climate regions of South Africa listed among 25 global biodiversity hot spots is cause for concern, especially in terms of the wildflower diversity which forms the basis of a growing lucrative nature-based tourist industry in a region unique in terms of its rich floristic diversity and endemism. These alien grasses are known to impact on ecosystem structure by decreasing floral and faunal diversity through widespread and aggressive competition with native species. However, unknown are the physiological mechanisms underlying competitive interactions between alien invasive grasses and native taxa, and how these are modified by resource supply. These mechanisms were examined by comparing the photochemical performance, photosynthesis, growth and reproduction of a typical native geophyte *Tritonia crocata* (L.) Ker. Gawl. cultivated in monoculture and in mixture with an invasive European annual rye grass *Lolium multiflorum* Lam. in a replacement series design under 8 different combinations of water and nutrient supply in a passively ventilated greenhouse. Significantly reduced concentrations of photosynthetic pigments (chlorophyll *a* and total carotenoids), diminished photochemical efficiency (phenomenological energy fluxes per leaf cross sectional area for absorption, trapping and transport), decreased rates of photosynthetic gas and water exchange and abundance of the photosynthetic enzyme Rubisco, as well as diminished vegetative and reproductive biomasses were observed in *T. crocata* grown in mixture with the invasive grass. These adverse effects were modified by level of water and nutrient supply, those of greatest magnitude apparent under conditions of high water and nutrient supply. The more effective competition for soil water resources by the invasive grass appeared the principle mechanism underlying the observed photosynthetic and growth inhibition in the native geophyte.

doi:10.1016/j.sajb.2007.02.150

The probable use of *Pistia stratiotes* as a bioindicator of Cadmum and Zinc pollution in water

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The growth of *Pistia stratiotes* in an industrial effluent obtained from a battery factory was investigated over time. This was to access its suitability for use as a bioindicator of heavy metal pollution. An assay of the concentrated effluent showed that Cadmium (Cd) and Zinc (Zn) were found to be present at 0.415 mg/l and 0.80 mg/l respectively. The plants were grown in full and half strength concentrations of the effluent. By the third day, plants grown in full concentration of the effluent showed signs of stress and chlorotic by the seventh day. The plant parts analysed showed that the leaves and roots of the young plants took up high quantities of the heavy metals than the mature plants with the roots however took up more heavy metals than the leaves. *Pistia stratiotes* can be used as a bioindicator of Cd and Zn pollution streams as it responds quickly to their presence in water.

doi:10.1016/j.sajb.2007.02.151

Storage of *Saccharum* spp. germplasm under minimal growth conditions

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Micropropagation of *Saccharum* spp. germplasm is used routinely in our laboratories for rapid production of new cultivars. At times, due to greenhouse and field constraints, it is necessary to hold back material in culture. For this purpose, methods are being investigated to slow down growth and development at two culture stages, *viz*. before somatic embryo maturation and before plantlet acclimatization in the greenhouse. The protocol for plantlet regeneration via somatic embryogenesis comprised placing immature leaf segments as explants on an initiation medium (MS, 0.6 mg/l 2,4-D, 20 g/l sucrose, 0.5 g/l casein hydrolysate and 8 g/l agar) in the dark for six weeks, and then on the same medium without 2,4-D for four weeks under a photoperiod. Storage of immature somatic embryos was attempted three weeks after initiation by transferring the cultures to minimal growth conditions (1/2 MS, 5 or 20 g/l sucrose, 0.6 mg/l 2,4-D, at both 18 and 24± 2 °C) for 6, 12 and 18 weeks, after which they were placed on regeneration medium. Storage of immature embryos was successful for 12 weeks under all of the treatments tested, with the lower sucrose regime resulting in greater plantlet yields than the control at both 18 and 24 °C. Some of the storage treatments resulted in fewer albino plants than the control. For storage of whole plantlets prior to acclimatization, the effect of MS strength, gelling agent, ABA concentration, high osmoticum and temperature on plantlet survival was tested for eight months. The highest survival rates and shoot re-growth after

retrieval was observed on MS, 20 g/l sucrose, 2 g/l Gelrite at 18 °C. Molecular analysis is presently being undertaken to determine if the storage treatments have an effect on the stability of the genome.

doi:10.1016/j.sajb.2007.02.152

Edge effects of fragmented grasslands along urban–rural gradients in selected areas of the North-West Province, South Africa

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Temperate grasslands are one of the worlds major biomes and include some of the most diverse and productive terrestrial ecosystems. In South Africa the Grassland biome is regarded as a critically threatened ecosystem, second only to the Fynbos biome. An increasing demand on land by human populations and urbanization has led to the reduction and fragmentation of natural grasslands severely threatening the biodiversity in these areas. Fragmentation can be regarded as the loss of patch size and increased isolation of habitat patches. These fragmented habitats have higher perimeter to surface area ratios than continuous habitats and are therefore thought to be more vulnerable to invasion by exotic species and loss of indigenous species. This is called the edge effect. In this study the edges of grassland patches were compared along an urban–rural gradient. The depth of edge influence of all the patches were quantified by means of a two dimensional edge detection technique called block kriging. Edge effect boundaries in rural grasslands were sharp and continuous with a low depth of edge influence, while the edges of urban grasslands were more difficult to characterize. The urban grasslands have a greater depth of edge influence due to exogenous disturbances which resulted in a high cover of exotic species at the interior of some sites. This study indicated that urban grassland edges are different to those of rural grasslands, but are comparable to fragmented grasslands studied in Melbourne, Australia.

doi:10.1016/j.sajb.2007.02.153

Evaluation of medicinal plants and synthesized naphthoquinones on cancer cells

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A naphthoquinone, 7-methyljuglone and some of its derivatives were synthesized, and characterized by their chemical and spectroscopic analysis. All 18 synthetic derivatives were tested for their inhibitory activity on three human cancer cell lines: breast adenocarcinoma (MCF-7), cervical epithelial carcinoma (HeLa) and oesophageal carcinoma (SNO). Two derivatives were found to be with very good anti-cancer activity. The 50% inhibitory concentration of these derivatives ranged from 1.087 to 4.736 μg/ml on the cell lines. The parent compound 7-methyljuglone was less active than several of its derivatives. However, the two positive controls doxorubicin and zearalenone were more effective than any of the synthesized derivatives. From the results it is clearly evident that most of these synthetic derivatives have got anti-tumour activity. Six ethanol extracts of plants were also tested on these cell lines. The IC_{50} values of the extracts ranged on HeLa cells between 21.18±2.53 and 52.38±1.637, and marginal activity were found on the other two cell lines. Identification of bioactive principle/s from the ethanol extract of *Foeniculum vulgare* is underway. Lead extracts and/or compounds will be further tested for their anti-tumour activity.

doi:10.1016/j.sajb.2007.02.154

Plant communities on uranium-ore bodies in the "Karoo Uranium Province", Beaufort West district

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The demand for nuclear power has increased over the past 10 years. The price of uranium, subsequently, also increased and has led to renewed interest in the metal. An alternative, biological method of prospecting for deposits, is more economic, time saving and more environmentally friendly than conventional methods. The aim of this study is to identify, classify, map and describe plant species and/or plant communities that are associated with uranium. The Ryst Kuil channel, a palaeo-river channel, is situated 45 km south-east form Beaufort West, Western Cape Province. The channel lies within in the Nama-Karoo biome, with the following vegetation units occurring: Gamka Karoo, Southern Karoo Rivers, Eastern Lower Karoo and Upper Karoo Hardeveld. According to maps no known uranium ore bodies occur on the two latter vegetation units. The vegetation of the study area (Ryst Kuil channel) as well a control area has been assessed by using the Braun–Blanquet method. Plant species/communities of the study- and control area were collected, compared and described. Soil samples were taken at each relevé and were analyzed with an Axios X-ray fluorescence apparatus for the presence of major- and trace elements. A total of 136 species were found in the study- and control area, which can be grouped into 5 major